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ART. I. *On the Anatomical Characters of Asiatic Cholera, with Remarks on the Structure of the Mucous Coat of the Alimentary Canal.* By W. E. HORNER, M. D. Professor of Anatomy in the University of Pennsylvania. (Part II.)

THE views offered in the preceding part of this article,* relative to the structure of mucous membrane, present at least, a degree of novelty by determining, with some precision, the whole number of the follicular pores of the alimentary canal, and how they are in every instance formed by meshes of veins, while the arteries enter only inconsiderably into their composition, to an amount in some measure comparable to the presence of the arteries in other erectile tissues, as the corpus spongiosum and cavernosum penis. In the latter it is familiar to every practised anatomist, that the branches of the arteries are but small, as they terminate in the cells of the penis, which are to be considered as only a modification of the incipient stage of venous trunks. If the corpus spongiosum were in fact spread out into a thin membrane, so as to line a hollow viscus, it would present no very exaggerated representation of what I have denominated the *superficial venous layer* of the alimentary canal; it being also admitted that within the circuit of every anastomosis a follicle was formed. Viewed on the preparations of the mucous membrane of the small and large intestines which I have, these follicles appear like puncta lachrymalia disseminated by thousands over every inch square, and existing so invariably upon every part that, as I have stated, the smallest calculation of their numbers puts them at from forty to fifty millions. It is now to be borne in mind, that it is the whole of this vascular and follicular structure, endowed

* No. XXXI. p. 58.

with vital actions the most important to life, and presenting in the aggregate an area of about thirteen square feet, the size of a small breakfast table, whose morbid derangements constitute the essential features of cholera. But it has been shown in some of my dissections, that this apparatus in the progress of cholera is detached entirely from the stomach and colon, in consequence of the excessive actions going on in them. The small intestines also, in some of my preparations, exhibit in patches a similar phenomenon; but as the entire observation has been presented to me in its true light only since the disappearance of the disease, I have no means of ascertaining the extent to which they suffer in this way.

The anatomy of the muciparous system of the alimentary canal unquestionably requires a more exact attention than has been heretofore bestowed upon it, especially so as to distinguish between that part which is really glandular, and the foramina or follicles now under consideration. The following extract will explain the difficulty which still exists in regard to a proper conception of the latter.

"The mucous glands, called also follicles or cryptæ mucosæ, are to the membranes of that name, what the sebaceous follicles are to the skin; that is to say, folds of the mucous membrane in form of *a cul-de-sac*, whose orifices open upon that membrane. These *follicles have not yet been discovered over the whole surface of the mucous membrane;* but here, as with the skin, analogy leads us to admit them. It is not long since they have been discovered in the pituitary membrane, where their existence had been denied. Be this as it may, we shall use the same observation upon these glands that was made on the sebaceous, viz. the impossibility of making an exact dissection of the capillary tissues does not allow us to discover all the forms of animal matter; but wherever a particular humour is found in a tissue, we are forced to conclude that this latter is organized in such a manner as to be able to produce it, and when in place of one humour we meet with many, we must acknowledge that the tissue is complex. Such is precisely the case with the mucous membrane of the digestive canal, and especially of the stomach, which could have a form of animal matter calculated to furnish digestive juices, although no gland destined to that purpose is discoverable."*

This desideratum of positive evidence, instead of the inductive, is clearly supplied to M. Broussais by my preparations. In infancy especially, the glands have a sensible thickness, which enables us to see them, but the smallest of them require the aid of a microscope,

* Broussais' Physiology. First American edition, p. 419.

and appear to have been described by Galeati.* As the paper is not to be had in any of the public libraries of this city, I can only quote from it on the current authority of anatomical works. In a note to the anatomy of the human body by Sir Charles Bell, article Intestine, it is stated as follows:—"It has been supposed that the fluids excreted from the surface of the intestines were furnished by very minute foramina, (which are visible by particular preparations,) in the interstices of the villi. See the letter of Malpighi to the Royal Society of London on the pores of the stomach, and the paper by M. Galeati in the Bologna Transactions, on the inner coat, which he calls the cribriform coat. The pores, according to Galeati, are visible through the whole tract of the canal, and particularly in the great intestines." Meekel designates these as glandular bodies under the name of glandulæ mucusæ, cryptæ miniinæ. Another order of glands are those of Brunner.† They are readily found in the duodenum at all ages; and particularly well in infancy, as low down as the ileo-colic valve. The third order are the glands of Peyer, discovered in 1677,‡ and are situated in the length of the ileum, where they form about thirty oval groups. The celebrated Ruysch appears also to have understood the existence of the follicles of the stomach, and Swammerdam to have had some idea of those of the small intestines,§ and he calls them tubuli glandulosi intestinorum interiores. I may here remark, that the account of the villi of the small intestines given by Hedwig, in his Disquisit. Ampullarum, &c. 1797, and which appears, from its introduction into Caldani's and M. Jul. Cloquet's Anatomy, to have a classical value, is, judging from my own preparations, too much a work of the imagination, executed under probably some fallacious views of the part itself: a cluster of cylindrical villi, with holes at the ends, would be an anomaly, fur those of the upper part of the intestines are either serpentine folds, as represented in my plates, with branches running into contiguous folds, or semi-oval plates; while those lower down are of a flattened conical shape, somewhat bent, bot in every instance they are destitute of what has been termed by Lieberkuhn an ampulla, and to my eye have uniformly polished surfaces, uninterrupted by foramina.

* *De cornea ventriculi et intestinorum tunica.* Comm. Bonon. 1745.

† Glandulæ intestini duodeni vel pancreas secundarius, discovered in 1715. See Mangetus, Theat. Anat. where this paper is introduced with the plates illustrative of it.

‡ See also Mangetos for the description from Peyer, with his plates.

§ Mangetus Theat. Anat. Vol. I. p. 310.

Masoagni has also introduced views of a good kind in regard to the follicular structure of the stomach and colon.* But it is to Sir Everard Home, that we are indebted for one of the best papers on the glandular structure of the stomach of different animals.†

As the real muciparous glands have an orifice leading into each, by the admission of anatomists, the follicles described commonly by them, are of this description, and are not comparable in number to the follicles found in the venous meshes. The highest estimate of the number of the former, as made by Mr. Lelut, fixes them at about forty-two thousand.‡ In consulting many of the distinguished modern authorities on this subject, there seems to be scarcely any thing in the anatomy of the intestinal canal which is presented in a more indefinite way; especially in regard to the small intestines, than the difference between the follicles, properly speaking, and the glands; and none of them, so far as I know, have undertaken to approximate the entire number of the follicles.

This digression will probably be pardoned, for the reason that, in treating of cholera, errors of a fundamental kind, from a want of suitable knowledge in the minute structure of the alimentary canal, are introduced into writings of great weight; as I shall have occasion to show in the progress of this paper.

In admitting the central point of cholera to be in the abdomen, there are three leading theories which profess to explain the character of the lesion. One of them is the nervous theory; the second that of passive vascular congestion; and the third that of acute inflammation.

A writer who has enriched the pages of this journal§ by an ingenious and excellent paper on malignant cholera, my friend Dr. Hodge is among the firm supporters of the first theory, under the following proposition. "I have no hesitation, however, in expressing the opinion, founded on an attentive examination and consideration of these facts, that there is a sedation of organic life in the alimentary canal; especially that there is a diminution of capillary excitement throughout the whole extent of the mucous membrane, from the mouth to the rectum in all cases of a simple uncomplicated character." (p. 408.) Again. "From this review of appearances during life and after death,

* *Prodromo della grande anatomia.* Tab. xiii.

† Phil. Trans. 1807 and 1817.

‡ Bouillaud, Traité du Choléra, p. 256.

§ Vol. XII. p. 386.

we infer that there is a sedation of the organic actions in the incipient as well as the confirmed cases of cholera, on internal as well as external surfaces, uf the large blood-vessels and the heart, as well as of the capillaries." (p. 409.) "The conclusion to which we have been brought is, that in cholera maligna there is *a universal sedation of the organic life*, manifested primarily in the capillary tissue, then in the larger vessels and heart, with a consequent passive congestion of an impure blood in the internal tissues, aggravating the sedation, and resisting the natural disposition to reäctiun; and that there is also a peculiar and morbid irritability uf the oerebro-spinal nervous system, the apparatus of animal life." (p. 419.)

Mr. Annesley* says I regard epidemic cholera therefore as essentially an affection of the nervuus system, and consider the diminution of the nervous power to be the proximate effect of the efficient cause of the disease—that cause being the electrical condition of the air, arising frum or accompanied by terrestrial exhalations of a kind unfavourable to animal life.

Another advocate of the nervous doctrine of cholera, is Mr. J. Delpech,† who gives the following summary of his observations. "The common and ordinary result has been a remarkable alteration, principally of the semilunar ganglions. Those organs more voluminous, and of a texture less dense than the nerves of the adjoining plexuses, have probably retained better the traces of the physiological alterations which they had experienced; they have often shown themselves swollen, red, more or less strongly injected, and sometimes softened to a very remarkable degree. The injection which penetrates them, colours them red, when in all the remainder of the body the capillary system is injected black. This very remarkable phenomenun cannot fail tu recall the painful sensation which occurs so constantly in the prodromes, and in the beginning of cholera, and the precise seat which it occupies.

"The solar plexus is likewise in an unnatural state, which is more or less obvious, but always perceptible by the size of the nerves which compose it, often by the red injection of their neurilema, and sometimes even by the softening of the nerves which form it, which are then ruptured by the slightest effort, or the lightest pressure. This plexus is then formed by broad red bands, and not by filaments of a grayish white as in the natural state.

"The renal plexuses have presented sometimes alterations of the

* Diseases of India, p. 147, London, 1825.

† Etude du Choléra Morbus en Angleterre et en Ecosse, p. 196.

same kind, but they have not showed themselves so frequently, and never with the same intensity. The affection appears to have been a simple extension of that of the adjoining nerves.

"The same appears to have been the case with the pneumogastric; its inferior part has been seen by us swollen and coloured red, and only by an extension of the alteration of adjoining nerves; this point alone has seemed to have preserved the material traces of an affection which probably had extended further in the length of this nerve. In one case alone the pneumo-cardiac plexus has exhibited itself likewise composed of nerves more voluminous than common."

The preceding extracts from M. Delpech may be considered as exhibiting the very incarnation of the nervous theory, which has likewise its advocates to some extent in Germany. In opposition to this it may be remarked, that the general testimony of anatomists so far from concurring in it, is adverse; and that in admitting the observations of M. Delpech to be correct to the extent of the cases to which they are applied, they do not harmonize with the generality; and must therefure be left with their appropriate weight to sume future day, when their value may be better understood.

Of the advocates of congestion, M. Magendie holds a most conspicuous rank,* and has sustained his views with a degree of strength and ingenuity, in harmony with his emiuent talents as a physiologist and practitioner. Having however taken a wrong point of departure, he has as might be expected from a logical and well disciplined mind, by keeping up its inferences, gone remarkable astray from the truth, and from the host of able men by whom he is surrounded. According to him, the fundamental phenomenon of cholera is a suspension of the circulation, which arises principally from a debilitated contraction of the ventricles of the heart. "Behold," says he, "the character, and principal and general fact of the blue cholera. The ventricles of the heart being debilitated, there results cold, discoloration of the face; and as the feebleness of the contractions proceeds incessantly, the result is the very remarkable fact of the stagnation of the blood in the veins, and the blue colour of the skin." (p. 13) In support of this hypothesis, Mr. M. brings forward the evidence of a similar colour produced by an experiment, where, by a mechanical impediment to the arterial circulation in the leg of a dog, he has found the stagnation of bluod to occur in the veins.

In opposition to this, it may be stated that in fainting there can be no doubt of the action of the ventricles of the heart being weakened;

* Lecons sur le Cholera Morbus, Paris, 1832.

and yet instead of its giving rise to a blue colour from the stagnation of blood; pallidness, and recession of blood from the capillaries is its invariable character. The general capillaries unquestionably execute languidly in cholera their office of forwarding the blood, and we may hence rationally infer that they are affected with atony; but does it not appear more probable that the latter is a sympathetic condition produced by the extreme pathological actions of the mucous membrane of the alimentary canal, the sympathies being conveyed either by the great sympathetic nerve, or by that more refined innervation of parts of which anatomy knows so little, but which unquestionably exists.

Another fundamental proposition of M. Magendie, is that the first effect of inflammation is to obliterate the capillary vessels by which the arterial system communicates with the venous. But he finds that in cholera an injection of water passes easily from the arteries into the veins of the intestines, and in doing so the stagnated blood of the latter is removed; therefore the capillaries are not obstructed, and consequently there is no inflammation.

This proposition, like the first, has certainly notable exceptions; no one can doubt that a blister is attended with inflammation, and yet we find in many cases of recent vesication the redness to disappear on death. Most cutaneous eruptions, which are unquestionably an inflammation, as measles and erysipelas, disappear on death; and yet by a minute red injection, they can be brought out again, showing that though the blood has been removed from the part, yet its channels still retain the type of inflammation.

Mr. M. avoids the consequences of the inflammatory lining and deposites found in the alimentary canal, by considering them to be intestinal mucus mixed with serosity, and the declaration that he has seen the same on the alimentary canal of executed criminals, and that he has even found the lining to reform itself three or four times on being cleared away, (p. 75.) In opposition to this, I may state, that if there be any criterion whatever, whereby coagulating lymph may be proved not to be mucus, that criterion judges clearly the case of cholera. Of the several tests, spirit of wine is one of the most accurate, by its coagulating fibrine firmly, while its action is comparatively inefficient on mucus.* By the application of such a test to the fibrinous secretion of cholera, the merriment of M. M.'s class at the idea of a violent inflammation producing a fluid like rice-water, would probably have been converted into an admission of the fact.

M. Magendie to get rid still more of the obligation to consider

* See Case III. p. 68, of this Journal.

cholera as an inflammatory affection, simulates its discharges by injecting water into the artery of an intestine, which as every anatomist knows, exudes into the cavity of the intestine; and then he says, "behold an intestinal liquor formed after death, here is an anatomical fact. We have often seen the discharges of cholera which had entirely the aspect of this liquor. If it had been taken from a close stool, it would have passed for the secretion of cholera." He finds the same phenomenon still better by injecting a vein. He has, however, no small difficulty in reconciling his idea of a stagnation of blood in the intestines with so large a discharge from them; his hypothesis is that it may be supposed that the blood concentrated in the venous system, and pushed back towards the intestines by the efforts to vomit, is diffused upon the intestinal canal and there effused; but the value of his theory is immediately lost, by a declaration that it is only the most probable conjecture adapted to the case, and that whoever affirms positively the mode of this phenomenon, either abuses himself or abuses others. This paragraph is so remarkable that it is worth while to give the whole. "There is not, I think, any data within the knowledge of physiologists of which I am completely ignorant. I then affirm that one cannot explain entirely the secretion which occurs in the intestinal canal; and still less would I look for an explanation of this secretion in the follicles which exist in the intestinal canal. When we have studied with attention the mode of this secretion, it is known that the greatest part of this secretion is not made by the follicles, because they are in too small a number to discharge so great a quantity of liquid. They concur, I admit, to the intestinal secretion, but they cannot be regarded as its only source. In fact, when you take a living animal, you cut open its intestine and expose its mucous membrane, you will scarcely have wiped it dry before a new layer of mucus appears. It is not by the follicles, but by the mucous membrane itself, that the intestinal secretion is made; this point of physiology is beyond any kind of difficulty." (p. 86.)

This passage may be considered as proof positive, that M. Magendie has yet to be informed that the whole amount of follicles in the alimentary canal is not far from fifty millions, though the fact may be still unsettled, whether they absorb as well as secrete, by inverting their action according to circumstances, as we see in serous membranes.

In the midst of the obscurity and entanglement of these and other speculations of the celebrated professor, there are traits of light of much value. Thus he considers that so long as the intestinal circula-

tion proceeds, there is an absorption by its veins, for he repudiates wholly the idea of liquids being taken up by the chyliferous vessels. The rapidity of this absorption will consequently depend on that of the circulation; the latter being retarded in the cold stage, absorption is slow; thus commonly it requires five minutes in a cholera patient for an enema of camphor to be perceived in the breath; while one minute only is requisite in other cases of sickness.

M. Magendie having once determined his fundamental point, of a weakness of the ventricles of the heart and a consequent torpor of the circulation, producing the appearances of the alimentary canal, subsequently applies this principle to every other organ of consequence, and finds a complete solution of its state through this master key of theory; it will be unnecessary however, to trace him through the whole problem, as its primary defects are sufficiently obvious.

The third class of pathologists are those I have said who consider the local phenomena of cholera on the alimentary canal as inflammatory. Should a question of such obscurity arrive at a determination by mere numbers, the verdict would certainly be in their favour.

In our own country, two of its most eminent professional authorities, besides many others, are the advocates of this doctrine.*

The concurrence of the British surgeons of India in this opinion is remarkable.† Their observations show that the internal organs generally, were in a state of high venous congestion, with inflammation of the alimentary canal. Dr. De Gravier, the chief French physician at Pondicherry, saw the inflammation of the stomach and intestines so well marked, that he considered it to give rise to all the other symptoms by means of irritation, and went so far as to call the disease gastro-enteritis. Mr. Corbyn‡ details such appearances of inflammation in the stomach and bowels as should leave no doubt of the fact, and among other indications of it, the inner surface of the stomach was frequently seen lined with *coagulating lymph.*

The general concurrence of the French pathologists in regard to the inflammatory nature of the lesions of the alimentary canal in cholera, is also opposed by as few dissentients as that of the British surgeons in India, and if any thing could have been pre-

* See American Journal of the Medical Sciences, Vol. XII. Lecture on Cholera Morbus. By N. Chapman, M. D. Professor, &c. Personal Observations on Epidemic Cholera. By Samuel Jackson, M. D. Assistant to the Professor, &c.

† Reginald Orton. Essay on Epidemic Cholera, from p. 41 to 50, inclusive. London edition, 1831.

‡ *Treatise on the Cholera of India*, p. 179. Calcutta, 1832.

viously wanting in the force of this testimony, it would appear to be now complete, by the highly finished plates on the subject, of M. Cruveilhier, in his *Anatomie Pathologique*, Liv. XIV. Some of the more distinguished names of this side are Gendrin,* Bouillaud,† F. J. V. Broussais,‡ Gerardin et Gaimard.§ An exposition of the testimony of several of them, as well as that of other persons, has been given with much fairness and ability by the editor, in Nos. XXI. p. 138, XXIV. p. 442, XXIX. p. 181, &c. of this Journal, and in Nos. 15 and 16, Vol. I. of the Cholera Gazette. There is so little variety in their reports of dissections, that there can be no doubt of the appearances having been faithfully narrated.

The indications of inflammation were much modified by the period of the disease at which death ensued. If it happened in a few hours after the invasion, the alimentary mucous membrane was left in a state not differing materially from the normal one; if at a longer period, there was an evident redness, and at a still more distant period, the inflammatory condition was most unequivocally marked, under its ordinary characters of redness and infiltration of blood in the mucous tissue of the stomach, of the small intestines, and of the large. In some cases this inflammation was so excessive, as to amount to mortification.

The idea of inflammation in the first state has been rejected by some, especially by M. Gendrin,‖ who defines it as a phlegmorrhagia, meaning thereby simply a secretory irritation. The act of the cholera secretion he considers to be accomplished by the numerous follicles of the digestive tube. These follicles, according to him, dilate progressively, and augment in volume, which is announced by the precursory diarrhœa in the greater number of cases. But whenever the secretion becomes so abundant as to detract rapidly from the blood a large quantity of its elements, the cholera symptoms explode. One who has had the serous diarrhœa mildly for some days, finds the waste supplied by the circulation of the blood; his system is therefore much less disturbed than it is in another who has lost much less, but in whom the discharge has supervened suddenly, and consequently where the power of repair from the circulation does not go on with equal rapidity. The remark is almost universal, that the cases of cholera terminating most rapidly in death, are those where there has

* *Monographie du Cholera Morbus.* Paris, 1832.
† *Traité, &c. du Cholera Morbus.* Paris, 1832.
‡ *Cholera Morbus, Epidemique.* Paris, 1832.
§ *Du Cholera Morbus in Russie.* Paris, 1832.
‖ P. 137.

been little or no serous discharge externally, for it is accumulated in such a flood almost at once in the alimentary canal, that the muscular energy of the latter, like that of every other part, is too much prostrated to perform its peristaltic movements; it is hence not uncommon to see the digestive canal in a state of relaxation, which bears an analogy to no other disease scarcely, except cases of protracted and extreme ascites.

The following from M. Gendrin will probably explain more satisfactorily his ideas of the early pathological condition of the alimentary tube. "The intestinal secretion by the follicles, being augmented, is necessarily attended by an active fluxion towards them, which may either precede or follow their excitement. This fluxion is necessarily accompanied with turgescence of the secretory organs, as in other cases of augmented secretion. From this turgescence or orgasm to inflammation, there is but little distance. The secretory orgasm is a minor inflammation, which explains the facility with which intestinal inflammations, and especially the follicular, are developed in the reäction of cholera, when the circulation being augmented, it becomes a general excitant for all the parts." From this it will be seen, that though M. Gendrin disavows inflammation, except in the stage of reäction, yet he admits a condition closely allied to it. For my own part, considering the rapid secretion from the alimentary canal of serum and of fibrin, and knowing that this act itself is calculated, as in pleuritis, to relieve the inflammatory congestion of the vessels, I have but little difficulty in viewing cholera as a decided inflammation from the beginning. How often is it in recent peritonitis or pericarditis, or in fact any other serous inflammation, that the serous tissue itself scarcely presents in its texture, or by the accumulation of blood in it, any trace of inflammatory action, so that if the fibrinous layer formed upon it is removed, the membrane appears healthy, and yet the plainest possible evidence exists of inflammation by the tenor of the symptoms preceding death, and by the accumulation of fibrin and serum in the cavity. By parity of reasoning and of observation, the inflammatory action disappears, on death, from the digestive mucous membrane, though we see its unequivocal evidence in large collections of serum, and in a fibrinous lining adhering to its surface, with a tenacity quite equal to that with which a similar lining adheres in croup or pleuritis.* If the digestive canal could be kept stationary, so as to allow the factitious membrane the same chances of adhesion, and of increasing its thickness,

* See Cases II. and III.

which exist in fixed cavities, it would probably exceed what is known in any other disease; but the peristaltic motion being violent, the membrane is detached almost as soon as formed, and being broken up in the long route that it has to traverse, its membranous character is destroyed, it is ground into fine pieces, the mixture of which with serum constitutes the cholera fluid.

To revert now to the fundamental doctrines of this paper.* In regard to the existence of a layer of coagulated lymph on the surface of the digestive canal, in corroboration of my own observations, we have the testimony of Corbyn, for the same being found in the disease as it appeared in India, and of Gerardin and Gaimard, of a similar occurrence in that of Russia. The latter indeed states that the sanguineous afflux, or the active congestion directed upon the intestinal tube, appears to be concentrated chiefly upon the mucous coat of the small intestine. This membrane is swollen, spongy, impregnated with a white fluid; the exudation of which it is the seat, at first clear and aqueous, takes a more consistent aspect, and forms a lining to it of a flocculent or gelatinous layer sufficiently like *a pseudo-membrane.* They add, indeed, what I have never seen, that this layer is sometimes traversed by very fine capillary vessels, which are remarked principally at the points which adhere the most strongly to the membrane of the intestine. There could not be a better evidence than this of the analogy of this layer of fibrine, with that of pleurisy or pericarditis, the uniform tendency of which is to become organized by vessels shooting into it. In one specimen, which fell under my notice, the adhesion was so strong between the jejunum and this factitious membrane,† that I regret not having injected minutely the part, with the view to test this very question. The case, it will be observed, terminated in eight hours from the invasion, and was attended with a strong inflammatory tinge. The mucous membrane here on being put into spirit of wine, and suspended as a preparation, presented that turgescence in its structure and villi, and apparent impregnation with a white liquor just spoken of. Many of the writers on cholera, speak of an inspissated layer on the surface of the digestive tube, but it appears most commonly to have been mistaken for mucus, while unfortunately such as have had a distinct comprehension of its character, have not brought it forward with that force which so main a feature of disease merits. A feature which, when once recognised, would settle determinately the grade of this malady.

* See p. 59.

† See Case III.

Another character which I have attributed to Asiatic cholera, is *a copious vesicular eruption*, entirely distinct from the tumefaction of villi, muciparous glands or follicles, and pervading the whole canal. This eruption has been seen by me in four cases, and I would suggest might possibly have been seen in others, had my familiarity with its appearance and means of detection been accurate, from the beginning. The form of this eruption* is that of a spherical vesicle, commonly from one-eightieth to one-hundreth of an inch in diameter, with parietes transparent and empty in the dried state, in which alone I have seen it for the reason, that when its parietes are impregnated with a liquid, as water, alcohol, turpentine or varnish, they are so transparent, that they cease to reflect light in an appreciable manner. This vesicle lies upon the surface of what I have designated the superficial venous layer of the digestive canal, perfectly distinct from the follicles, that is to say, having for its base the venous partition between the follicles. In the colon, where the edges of the latter are on the same plane, the vesicles repose as distinctly on the surface of the mucous membrane as marbles would on a table, and very much after the same manner, one point alone of their circumference resting on the mucous membrane. If it should be permitted me to form a conjecture of the nature of their parietes, I would say that they consisted of the cuticle of the digestive canal. They no doubt contain a fluid in the recent state; but what its character is I have yet to learn, from the difficulty of distinguishing the vesicles themselves at that period.

These vesicles in some parts of the jejunum are as thick as they can possibly stand, which, according to the estimate of their size just given, would be at the rate of some thousands to an inch square, actually six thousand four hundred; but as I have never seen an entire inch square covered in this way, an erroneous impression might be conveyed by stating it as the rule. These vesicles exhibit a decided preference to the roots of the valvulæ conniventes, and are there closely disseminated with scarcely an interval between them; but they decrease in frequency towards the summits of the valvulæ. Their entire number and frequency decline greatly in the ileum and colon, the individual vesicles being much insulated, so as to leave wide spaces between them and others. Case VIII. exhibited these vesicles to a remarkable degree in the jejunum.

In Case XII. I observed, besides the vesicles, which were as distinct

* Cases I. V. VIII. XII.

from each other as marbles on the same ground, that some were clustered. In the stomach I found a single bunch resembling a bunch of grapes standing on its base; and in the ileum and colon I found clusters resembling bunches of grapes reposing on their sides. Such clusters had for their nidus and for connecting them together, a deposite of coagulating lymph.

An eruption upon the alimentary mucous membrane has been perceived before, but it appears to me, as far as I can judge from the description, of characters very distinct from what I have delineated. Thus Professor Wagner, of Vienna, besides granulations of the size of a pepper—corn or pea, on the surface of the mouth and pharynx containing pus, found a similar appearance of the size of half a pea on the stomach, surrounded by a spot of redness. And having verified the observation on the stomach, found them more frequently in the whole track of the small intestines. They were considered as mucous follicles altered by inflammatory action.*

The pathological appearance which corresponds more than any other with what I have described, is that announced by MM. Serres and Nonat, in the French Lancet for April, 1832, under the name of *Psorenterie*. According to them, it is so little apparent in some subjects, that it would not be perceived without much attention, but very apparent in others; it is found to occupy one-half or two-thirds of the intestinal canal, beginning at the end of the ileum, where it is always larger and more approximated. On one occasion it was seen on the duodenum, where it had gained the free margin of the valvulæ conniventes.

The corpuscles of the psorenteric eruption vary in volume from that of a grain of millet or hemp, to the half or quarter of that of a pin's head. Their colour differs a little; but their structure is always the same. They are of a grayish-white in the largest, and of a light rose or flesh colour in the smallest. When examined by being cut open with a sharp knife, they seem to be formed of a simple tissue. From this trial it results that when compressed with the nail, they leave a slight but flattened elevation at the points they occupy. They are depressed almost as much by the nail alone, without previous incision, and under no circumstances do they discharge a liquid; hence it is inferred that they are not engorged follicles. They are formed both in the early and in the advanced dates of cholera,

* Medical Magazine, No. IV. Observations on Cholera. By Charles T. Jackson, M. D.

and exist, according to M. Bouillaud, at the rate of five times in forty-five.*

In the north of Europe this eruption has been considered as composed of tuberculous granulations, connected with the lymphatic system, as they are easily filled from it, but not from the blood-vessels.† M. Bouillaud, on the contrary, (p. 256,) considers them as the glands of Brunner in a state of development, and says, that to one who has seen them in their confluent form, the estimate of Mr. Lelut in fixing the whole number of mucous follicles in the digestive canal at forty-two thousand, will not appear excessive. He says also, that they vary in size from that of a small millet to a large hemp seed; that their form is rounded and granular, and that many present a black point at their centre. There are some where the latter trait is absent. MM. Serres and Nonat consider them as papillæ in a state of tumefaction; but M. Bouillaud says, that he is sure that an immense majority of them are developed follicles, though he would not deny the existence of some where there is a deficiency of the black point in the centre, which is the indication of the mouth of a follicle. The colour of the follicular granulations is commonly of a grayish-white, sometimes red; and their base is very often the seat of an injection of variable redness.‡

A careful perusal of the above description of the psorentery of MM. Serres and Nonat, will satisfy the reader that the eruption which they describe, is different in many particulars from the one announced by myself, that the latter consists of vesicles forming entire spheres, hollow, and much smaller in diameter; and that it may be considered as a specific eruption of cholera heretofore unnoticed. Appended also as it is to the surface of the *superficial venous layer*, it is never seen in places where the latter has been lost in the progress of the complaint; whereas, the psorentery of M. Serres is seen under all circumstances of morbid change noticed by its describers.

The precise state of the *venous* system of the digestive canal is among all the traits of cholera, that which will most fully account for its destructiveness to human life. The minute anatomy of this system has been explained at page 60 and the following, and we now resume the general fact, that the mucous membrane is formed by an intertexture of these veins, resembling a net, or more exactly a plate

* *Rochoux sur le Cholera Morbus*, in Archives Générales de Medecine, Vol. XXX. p. 333. Paris, 1832.

† Gerardin et Gaimard, second edit. p. 139.

‡ Loc. cit. p. 257.

of metal pierced with holes; these holes being the follicles, whose aggregate number is forty-six millions at least, and probably much more. When cholera has lasted for a few days, this venuus intertexture, which I have denominated for reasons stated, the *superficial venous layer*, is exfoliated from the stomach, and large intestines especially, but also in a degree from the small. The first case in which I became certified of this fact, was VIII. where, upon making a minute injection of arteries and veins, and drying it, not a trace of the superficial venous layer was left in the pyloric half of the stomach, it being the portion injected; the other half, it will be seen from the report, was also disorganized, and may have been in the same condition; but as it was not injected, this is a mere inference. The ileo-colic intestinal region was in the same state generally, except that a small patch of the superficial venous layer was left near the valve, and which was in the act of being detached from the colon; in the dried state it resembled cuticle; had received very partially the injecting material of the ileo-colic vein; had its follicles open, and could be raised up easily with the point of a knife.

This observation once made, was easily extended by the process of minute injection and drying, to other cases. I found the cul-de-sac of the stomach exhibiting it in Case V. and the ileum and colon also, there not being a single vestige of the superficial venous layer left in the latter. Case XII. which exhibits so fully the follicular arrangement of the pyloric end of the stomach, had suffered from the exfoliation of its mucous membrane in the left half. The exfoliation in this case seemed to be confined to the stomach, as sections of the small and large intestines became admirable subjects for studying the villi and follicles as seen in the plates.

The similitude in the recent appearances of the digestive mucous membrane of Case IX. to Case VIII. leaves me at the present day with the rational belief, that if it had likewise been tried by the same processes of injection and preparation, identical lesions would have been perceived. But an ignorance at the time of the value of the fact I was observing, prevented me from pursuing the inquiry. It has been, indeed, only after numerous examinations of my preparations for weeks in succession, that I have been brought to appreciate their evidence as stated in this paper. The disease having in the mean time ceased, it must devolve upon others to confirm and to complete my observations, wherever the opportunity is presented. As an incentive I will here remark, that any one who studies the pathology of cholera without the aid of minute injections successfully thrown in, has a veil over his eyes, and understanding too,

which will prevent him from recognising the most important feature in the whole series of anatomical facts belonging to it. For this feature I verily believe to be the sloughing of the *superficial venous layer* of the digestive mucous membrane. When this process takes place to any extent, we may readily believe that death is the inevitable consequence, from the great importance of the part lost.

Let us endeavour to form some estimate of the physiological influence of this process in its preparatory stages, and in its actual accomplishment. The most undeniable fact of cholera, is a rapid fluxion of the blood to the whole digestive mucous membrane, with a diminishing of its own volume by large losses at the part, as the immense serous discharges prove; but here is an action extending over an area of at least two thousand square inches, I say the size of a small breakfast table. The copious secretion of fibrine proves that this action is not a simple acceleration of the circulation, but an actual inflammation; this inflammation having reached a certain degree, and a certain duration, is followed by sloughing of the membrane itself, that is to say, the part where the most important actions of life occur, to wit, the *superficial venous layer*. Under such overwhelming circumstances of disease, can we wonder if the exterior symptoms of inflammation do not exist, that the inflammation instead of acting as a stimulus, as in common diseases, so as to diffuse the blood more rapidly towards the periphery of the body, increasing the heat of the skin and the volume of the arteries in the limbs &c. should on the contrary prostrate every action of the system, except on the surface where itself prevails. "The rapid and excessive evacuations of cholera, produce as it respects the volume and force of the circulation, precisely the same results as profuse hæmorrhage; and between a cholera patient in collapse, and one exhausted by hæmorrhage, many points of resemblance prevail."* In viewing the relation of a surface so vascular and so extensive with the entire circulation, its proportion is so large, that even a priori, the fact of universal fluxion in it being stated, we might conjecture the result in terms not very different from the actual event.

As it is not the design of this paper to enter on the whole question of cholera, I shall not engage in discussing the influence of the loss of serum upon the blood itself, and secondarily upon the state of all the organs supplied by the latter. The paper last quoted gives so satisfactory an exposition of this division of the pathological appear-

* Jackson on Malignant Cholera, American Journal of the Medical Sciences, Vol. XII. p. 114.

anees, that a recapitulation of it in this journal would be superfluous at present.

I doubt much whether any patient has ever lived long enough for this sloughing to occur over the whole digestive canal. Those cases where death follows in a few hours have probably a tendency to such a condition, but their very severity brings them to a termination before it can be realized; hence happens the remarkable testimony, that they exhibit the fewest and the least distinct traces of disease. That apparent paradox may be explained now, by the blood receding at death from *the superficial venous texture:* a phenomenon common, as I have remarked before, to all recent inflammations.

The majority of the cases of cholera probably suffer extreme violence only upon particular sections of the digestive mucous membrane; some have it in the stomach chiefly, as Case XII. others in the colon also, as Cases V. and VIII., others may have it chiefly in the small intestines. But in all cases some degree of irritation extends along the whole canal; the resistance of an individual to the disease will therefore depend mainly, upon the quantity of surface vehemently attacked. Upon this principle I can readily understand that individuals may recover where portions of the superficial venous layer of the stomach or intestines have been thrown off.

When a part is thus denuded, many mouths of veins are left patulous, as seen in my preparations, and pour out serum with small quantities of blood in some cases. The secretion, however, finally becomes purulent, as in a blister after the cuticle is removed; it is generally fœtid, and may be distinguished very readily in the evacuations from the sero-fibrinous ones which preceded it. Case VIII. was a strong illustration of this fact.

To what extent a mucous membrane when sloughed off may be repaired, is a point yet to be ascertained in this and other diseases, I believe myself in the possibility of its regeneration, and am not singular in the opinion.* It is probably the reparation of this injury which gives rise to what are called the diseases of reäction in cholera, many of which resemble strongly gastro-enteritic fever.

It remains for further researches to determine the uniformity of the vesicular eruption of cholera, as I have described it; and also to ascertain whether this is the specific disease which gives rise to so terrible a train of symptoms; whether cholera is in fact a sort of inverted small-pox, the location of which makes its ravages so fatal: and which,

* See Boyer's Anatomy, Article Stomach.

like the genuine variola, may be divided into the discreet and confluent kind, and has its symptoms always modified by the extent of the surface attacked. The epidemic character of cholera, its independence of all meteorological conditions of the atmosphere, and moreover its subjecting an entire community to its influence under some symptom or other, wherever it appears for the first time; show analogies with exanthematous diseases, which go far in my mind to establish the opinion, that cholera is really what those vesicles tend to show, an internal exanthema itself.

EXPLANATION OF PLATES.

PLATE I.

Fig. 1. Magnified section of jejunum, to show the convoluted arrangement of the villi, which resembles the convolutions of the cerebrum. This is taken from cholera case No. 8; but the same appearance has been verified on healthy intestines.

Fig. 2. Magnified section of ileum from lower part; it exhibits the conical form of the villi there; and the follicles between them, as thick as they can be placed, filling all the intervals of the villi. This piece is from a man who died from a wound of the thorax, with no intestinal disease.

Fig. 3. Magnified section of mucous coat, or superficial venous layer of stomach from the pylorie half, exhibiting its follicles of various sizes, and closely disseminated. Taken from cholera case No. 12.

Fig. 4. Magnified section; taken from left extremity of stomach of same patient. The mucous coat has here exfoliated, whereby the submucous vessels, they having been injected, are exposed, and have their orifices gaping upon the cavity of the stomach.

Fig. 5. Magnified section of mucous coat of colon from near the ileo-cœcal valve; it exhibits finely the superficial venous layer, and how the mucous coat is formed almost wholly by it, the follicles being in the meshes of the veins. Being taken from cholera case No. 12, a solitary vesicle A. broken on the top, is seen to lie on its surface like a marble on a board.

Fig. 6. Magnified section of colon from near ileo-cœcal valve, exhibiting the loss of the mucous membrane by exfoliation; the whole of the follicles have consequently disappeared, and the vessels are seen beneath injected. From cholera case No. 5.

Fig. 7. Magnified section from pyloric end of stomach in cholera case No. 8. The mucous coat, or superficial venous layer, being also exfoliated in this case, the follicles have disappeared, and the vessels beneath having been injected, are seen very distinctly, especially the veins, which have their orifices gaping into the cavity of the stomach.

Fig. 8. Magnified section of jejunum from cholera case No. 8. It exhibits to great advantage the cholera vesicles of various sizes, and their invariable spherical shape.

PLATE II.

Section of jejunum lined by a layer A. of coagulating lymph. It was taken from cholera case No. 3, and is now in the Anatomical Cabinet.